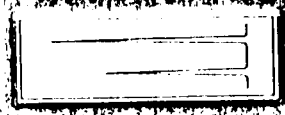
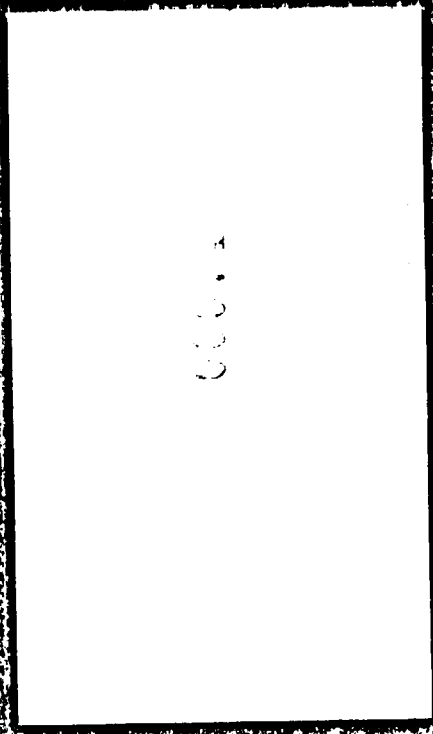


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**SHALLOW GROUNDWATER INVESTIGATION
AMERICAN CHEMICAL SERVICE INC.
GRIFFITH, INDIANA**

APRIL 1990

SUBMITTED BY:

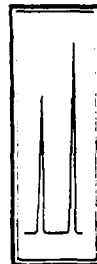
Karen L. Shess
Tracer Research Corporation

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INTRODUCTION

A shallow groundwater investigation was performed by Tracer Research Corporation (TRC) at American Chemical Service Inc. located in Griffith, Indiana. The investigation was conducted on March 26-29 and April 2, 1990 under contract to Warzyn Engineering Inc. The purpose of the investigation was to determine the extent of contamination by volatile organic compounds in the groundwater.

During the survey, a total of fifty-five groundwater samples were collected and analyzed from thirty-eight sampling locations. Samples were analyzed for volatile organic compounds from the following suite:

- benzene
- toluene
- ethylbenzene
- xylene
- total hydrocarbons (THC)

Xylenes are reported as the total of the three xylene isomers and total hydrocarbons are reported as gasoline range compounds consisting of approximately C₄-C₉ aliphatic, alicyclic and aromatic compounds.

The compounds in this suite were chosen as target compounds because of their suspected presence in the groundwater. Groundwater samples were screened on a gas chromatograph equipped with a flame ionization detector (FID).



EQUIPMENT

Tracer Research Corporation utilized a one ton Ford analytical field van that was equipped with one gas chromatograph and two Spectra Physics computing integrators. In addition, the van has two built-in gasoline powered generators that provide the electrical power (110 volts AC) to operate all of the gas chromatographic instruments and field equipment. A specialized hydraulic mechanism consisting of two cylinders and a set of jaws was used to drive and withdraw the sampling probes. A hydraulic hammer was used to assist in driving probes past cobbles and through unusually hard soil.

GROUNDWATER SAMPLING PROCEDURES

Sampling probes consist of 7 to 14-foot lengths of 3/4 inch diameter hollow steel pipe. Groundwater samples were collected by driving the hollow probes with detachable drive points below the water table. Once at the desired depth the probe was withdrawn several inches to permit water inflow into the resulting hole. Groundwater samples were collected between the depths of 5 and 15 feet below grade. Once inserted into the ground, the above-ground end of the sampling probes were fitted with a vacuum adaptor (metal reducer) and a length of polyethylene tubing leading to a vacuum pump. A vacuum of up to 24 inches of mercury was applied to the interior of the probe and open hole for 15 to 20 minutes or until the water was drawn up the probe. The water thus accumulated was then removed by drawing a vacuum on a 1/4 inch polyethylene tube inserted down the probe to the bottom of the open hole. Loss of volatile compounds by evaporation is accordingly reduced when water is induced to flow into the very narrow hole, because it can be sampled with little exposure to air. The polyethylene tubing was only used once and then discarded to avoid any cross-contamination problems.



Groundwater samples were collected in 40 mL VOC vials that are filled to exclude any air and then capped with Teflon-lined septa caps. Water samples were analyzed by injecting headspace in the sample container created by decanting off approximately half of the liquid in the bottle. Headspace analysis is the preferred technique when a large number of water samples are to be performed daily. The method is more time efficient for the measurement of volatile organics than direct injection because there is less chance for semi-volatile and non-volatile organics to contaminate the system as there is with direct injection. Depending upon the partitioning coefficient of a given compound, the headspace analysis technique can also yield greater sensitivity than the direct injection technique. Both methods are similar in terms of precision and accuracy.

ANALYTICAL PROCEDURES

A Varian 3300 gas chromatograph, equipped with a flame ionization detector (FID), was used for the analyses. Compounds were separated on a 3' by 1/8" OD packed column with OV-101 as the stationary phase in a temperature controlled oven at 60°C. Nitrogen was used as the carrier gas.

Hydrocarbon compounds detected in the groundwater were identified by chromatographic retention time. Quantification of compounds was achieved by comparison of the detector response of the sample with the response measured for calibration standards (external standardization). Instrument calibration checks were run periodically throughout the day and system blanks were run at the beginning of the day to check for contamination in the soil gas sampling equipment. Air samples were also routinely analyzed to check for background levels in the atmosphere.

The GC was calibrated for headspace analysis by decanting 10 to 20 mL off of the known aqueous standard so as to leave approximately the same amount of headspace that was in the water headspace samples. The bottle was then resealed and shaken vigorously for 30 seconds. An analysis of the headspace in the vial determined the Response Factor (RF) which was then used to accurately estimate water concentrations.



Detection limits for the compounds of interest are a function of the injection volume as well as the detector sensitivity for individual compounds. Thus, the detection limit varies with the sample size. Generally, the larger the injection size the greater the sensitivity. However, peaks for compounds of interest must be kept within the linear range of the analytical equipment. If any compound has a high concentration, it is necessary to use small injections, and in some cases to dilute the sample to keep it within linear range. This may cause decreased detection limits for other compounds in the analyses.

The detection limits for the selected compounds were approximately 0.1 ug/L, depending on the conditions of the measurement, in particular, the sample size. If any component being analyzed is not detected, the detection limit for that compound in that analysis is given as a "less than" value (e.g. <0.1 ug/L). Detection limits obtained from GC analyses are calculated from the current response factor, the sample size, and the estimated minimum peak size (area) that would have been visible under the conditions of the measurement.

QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

Tracer Research Corporation's normal quality assurance procedures were followed in order to prevent any cross-contamination of groundwater samples.

- . Steel probes are used only once during the day and then washed with high pressure soap and hot water spray or steam-cleaned to eliminate the possibility of cross-contamination. Enough probes are carried on each van to avoid the need to reuse any during the day.
- . Probe adaptors (TRC's patented design) are used to connect the sample probe to the vacuum pump. The adaptor is designed to eliminate the possibility of exposing the sample stream to any part of the adaptor. Associated tubing connecting the adaptor to the vacuum pump is replaced periodically as needed during the job to insure cleanliness and good fit. At



the end of each day the adaptor is cleaned with soap and water and baked in the GC oven.

- . Glass syringes are usually used for only one sample per day and are washed and baked out at night. If they must be used twice, they are purged with carrier gas (nitrogen) and baked out between probe samplings.

- . Injector port septa through which samples are injected into the chromatograph are replaced on a daily basis to prevent possible gas leaks from the chromatographic column.

- . Analytical instruments are calibrated each day by analytical standards from Chem Service, Inc. Calibration checks are also run after approximately every five sampling locations.

- . Subsampling syringes are checked for contamination prior to sampling each day by injecting nitrogen carrier gas into the gas chromatograph.

- . Prior to sampling each day, system blanks are run to check the sampling apparatus (probe, adaptor, 10 cc syringe) for contamination by drawing ambient air from above ground through the system and comparing the analysis to a concurrently sampled ambient air analysis.

- . All sampling and subsampling syringes are decontaminated each day and no such equipment is reused before being decontaminated. Microliter size subsampling syringes are reused only after a nitrogen carrier gas blank is run to insure it is not contaminated by the previous sample.



APPENDIX A: CONDENSED DATA

**WARZYN ENGINEERING/ACS/GRIFFITH, INDIANA JOB#1-90-155-S**

03-26-90

CONDENSED DATA

SAMPLE	BENZENE ug/l	TOLUENE ug/l	ETHYL BENZENE ug/l	XYLENES ug/l	THC ug/l
AIR	<0.04	<0.1	<0.2	<0.5	<0.4
GW1-6'	26	32	38	40	140
GW1-11'	1200	94	51	53	3600
GW1-15'	990	25	<2	<5	3000
GW2-6'	68	28	20	8	160
GW2-11'	440	<2	<2	<2	600
GW2-14'	1100	17	<2	540	2100
GW3-6'	<0.2	<0.3	<0.3	<0.4	<1
GW3-11'	<0.2	<0.3	<0.3	<0.4	<1
GW3-14'	<0.2	<0.3	<0.3	<0.4	<1
AIR	2	3	<0.3	<0.4	8

Analyzed by: P. Reko

Checked by: A. Hooper

Proofed by: L. Splander



WARZYN ENGINEERING/ACS/GRIFFITH, INDIANA JOB#1-90-155-S

03-27-90

CONDENSED DATA

SAMPLE	BENZENE ug/l	TOLUENE ug/l	ETHYL BENZENE ug/l	XYLENES ug/l	THC ug/l
AIR	<0.3	<0.3	<0.3	<0.5	<1
GW4-12'	61	2	<0.8	<1	84
GW5-12'	6	<0.3	<0.3	<0.5	10
GW6-5'	<0.3	0.3	<0.3	<0.5	2
GW6-10'	0.2	<0.3	<0.3	<0.5	0.8
GW6-14'	0.5	<0.3	<0.3	<0.5	1
GW7-6'	<0.3	0.3	<0.3	<0.5	0.7
AIR	<0.3	<0.3	<0.3	<0.5	<1
GW8-6'	<0.3	0.2	<0.3	<0.5	1
GW8-10'	<0.3	<0.3	<0.3	<0.5	<1
GW8-14'	<0.1	<0.2	<0.2	<0.3	<0.7
GW9-7'	6900	<6	<6	<11	8800
GW9-12'	5300	<6	<6	<11	6700
GW10-7'	27000	18000	<6	530	54000
GW10-12'	16000	13000	<32	970	34000
GW11-10'	62	<3	<3	<5	300
GW12-10'	170	<3	<3	<5	220
AIR	<0.3	<0.3	<0.3	<0.5	<1

Analyzed by: P. Reko

Checked by: A. Hooper

Proofed by: E. Splander



WARZYN ENGINEERING/ACS/GRIFFITH, INDIANA JOB#1-90-155-S

03-28-90

CONDENSED DATA

SAMPLE	BENZENE ug/l	TOLUENE ug/l	ETHYL BENZENE ug/l	XYLENES ug/l	THC ug/l
AIR	0.1	0.2	<0.1	<0.2	0.5
GW13-7'	<0.1	0.2	<0.1	<0.2	0.5
GW13-13'	<0.1	0.2	<0.1	<0.2	0.5
GW14-7'	0.2	0.2	<0.1	<0.2	4
GW14-12'	1	0.1	<0.1	<0.2	4
GW15-7'	0.2	<0.1	<0.1	<0.2	0.6
GW15-12'	5200	<1	<1	<2	6200
GW16-12'	4300	<1	<1	<2	4900
AIR	<0.1	<0.1	<0.1	<0.2	<0.5
GW17-12'	<0.1	<0.1	<0.1	<0.2	<0.5
GW18-12'	0.1	<0.1	<0.1	<0.2	0.5
GW19-12'	<0.1	<0.1	<0.1	<0.2	<0.5
GW20-9'	6	<0.1	<0.1	<0.2	6
GW20-14'	200	<0.2	<0.2	<0.4	220
GW21-13'	<0.2	<0.2	<0.2	<0.4	<1
GW22-13'	780	5	<0.2	<0.4	900
GW23-13'	940	<1	<1	<2	1100
AIR	0.4	0.4	<0.1	<0.2	1

Analyzed by: P. Reko

Checked by: A. Hooper

Proofed by: A. Saplender



WARZYN ENGINEERING/ACS/GRIFFITH, INDIANA JOB#1-90-155-S

03-29-90

CONDENSED DATA

SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES	THC
	ug/l	ug/l	ug/l	ug/l	ug/l
AIR	0.8	1	<0.1	1	3
GW24-11'	12000	<2	<2	<4	20000
GW25-11'	<0.1	<0.1	<0.1	<0.2	<0.5
GW26-11'	1	<0.1	<0.1	<0.2	3
GW27-11'	7400	5	<1	<2	15000
GW28-11'	<0.1	<0.1	<0.1	<0.2	<0.5
AIR	<0.1	<0.1	<0.1	<0.2	<0.5

Analyzed by: P. Reko

Checked by: A. Hooper

Proofed by: L. Splander



WARZYN ENGINEERING/ACS/GRIFFITH, INDIANA JOB#1-90-155-S

04-02-90

CONDENSED DATA

SAMPLE	BENZENE ug/l	TOLUENE ug/l	ETHYL BENZENE ug/l	XYLENES ug/l	THC ug/l
AIR	<0.1	<0.2	<0.2	<0.3	<0.7
GW29-10'	<0.1	0.1	<0.2	<0.3	<0.7
GW30-10'	2	<0.2	<0.2	<0.3	2
GW31-12'	6	0.3	<0.4	<0.6	8
GW32-12'	30	<0.3	<0.4	1	210
AIR	<0.1	0.1	<0.2	<0.3	<0.7
GW33-9'	27000	7	<4	4900	37000
GW34-9'	2600	<2	<2	<3	3300
GW35-9'	3800	11000	<2	10000	23000
GW36-11'	25000	<2	<2	<3	32000
GW37-11'	7	<0.8	<0.9	<1	9
GW38-12'	8	<0.4	<0.4	<0.7	10
AIR	0.3	0.3	<0.2	<0.3	1

Analyzed by: P. Reko

Checked by: A. Hooper

Proofed by: J. Splander